Upper and lower bounds for 3-dimensional k-within-consecutive-(r_1, r_2, r_3)-out-of-(n_1, n_2, n_3):F system

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Abstract As a 2-dimensional k-within-consecutive-r-out-of-n:F system, for example, there are connected-(r, s)-out-of-(m, n):F lattice system and 2-dimensional k-within-consecutive-(r, s)-out-of-(m, n):F system. For these systems, the calculation method for reliability and, upper and lower bounds, have been studied by many researchers. Furthermore, several reports have been proposed for the reliability of more multi-dimensional systems.

In this study, we consider 3-dimensional k-within-consecutive-r-out-of-n:F system, called the 3-dimensional k-within-consecutive-(r_1, r_2, r_3)-out-of-(n_1, n_2, n_3):F system. This system consists of $n_1 \times n_2 \times n_3$ components, which are arranged like a (n_1, n_2, n_3) rectangular solid. This system fails if and only if there is an (r_1, r_2, r_3) rectangular solid in which k or more components fails. In this system, although an enumeration method could be used for evaluating the exact system reliability of very small-sized systems, that method needs much computing time when applied to larger systems. Therefore, developing upper and lower bounds is useful for evaluating the reliability of large systems, in a reasonable time.

In this study, we propose the upper and lower bounds for reliabilities of a 3-dimensional k-within-consecutive-(r_1, r_2, r_3)-out-of-(n_1, n_2, n_3):F system, by the basic idea applied to the methods for the reliability of a 2-dimensional k-within-consecutive-(r, s)-out-of-(m, n):F system.

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